

# PATENT SPECIFICATION

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## (54) SLIDE HOPPER CURTAIN COATING

- (71) We, CIBA-GEIGY AG, a body corporate organised according to the laws of Switzerland, of Basle, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention relates to a method for curtain coating travelling web material and is an improvement of or modification to the invention described and claimed in our Patent No. 1,429,260.
- In Patent No. 1,429,260 there is described and claimed a method of coating a travelling web of material using a free-falling curtain of coating liquid wherein at least one of the two edge regions, of width at least 5 mm, of the curtain comprises liquid which is supplied by a feed system separate from the system which supplies liquid to the central region of the curtain between the two edge regions, the liquid supplied to the edge region or regions being compatible with the liquid of the central region of the curtain.
- Preferably both edge regions of the curtain comprise liquid which is supplied by a feed system separate from the system which supplies liquid to the central region of the curtain.
- By the liquid supplied to the edge regions being "compatible" with the liquid supplied to the central region, is meant that the liquids are able to join and form a single curtain across the width of the curtain. In practice there is very little admixture of the two liquids in the curtain.
- It is to be understood that the central region of the curtain may comprise several laminae which when they impinge on the travelling web form several layers of coating liquid thereon simultaneously. However preferably only one lamina of liquid is supplied to the edge regions of the curtain.
- In Patent No. 1,429,260 it is stated that the preferred method of coating a travelling web of material comprises forming a liquid free-falling curtain over the travelling web, wherein the said liquid free-falling curtain has a central region and two edge regions and wherein the liquid lamina (or laminae) of the central region of the curtain is composed of a liquid (or liquids when the central region consists of more than one lamina) which is (or are) different from the liquid or liquids present in at least one edge region of the curtain, but wherein the liquid (or liquids) in the central region of the curtain is (or are) compatible with the liquid (or liquids) present in the edge regions of the curtain.
- Preferably in this method the central region of the falling curtain comprises several laminae but the edge regions of the falling curtain consist of only one lamina of liquid.
- In one embodiment of the method described in Patent No. 1,429,260 the width of the central region of the curtain preferably is narrower than the width of the web being coated, but the total width of the curtain is wider than the web being coated.
- By use of the method it is possible in the edge regions to use cheap liquids which are compatible with the main coating liquid or liquids being used and thus when they overflow the edge of the web being coated they need not be collected or recirculated. For example if a travelling web is being coated with a gelatinous silver halide emulsion or emulsions, gelatin solution may be used at the two edge regions of the curtain. If required the gelatin solution may be recirculated in the edge regions.
- One particular apparatus for carrying out the invention described in Patent No. 1,429,260 is a slide hopper apparatus. Such an apparatus is shown in Figures 1—5 of Patent No. 1,429,260. When using such apparatus it has been found that if the surface tension in air of the liquid in the edge regions of the curtain is not very similar to the surface tension in air of the liquid in the central region of the curtain or if the interfacial tension on the slide of the liquid in the edge regions is not very similar to the interfacial tension of the bottom lamina of coating liquid which is in contact with the slide when a plurality of layers are

being coated as shown in Figures 5 and 6 of Patent No. 1,429,260 then there is a tendency for the width of the edge regions either in the falling curtain or on the slide  
5 either to increase or decrease depending on the surface or interfacial tension difference between the liquids. It is very difficult to achieve both a surface tension balance in the curtain and an interfacial tension  
10 balance on the slide at the same time by the adjustment of concentration of surface active agents. A method of helping to alleviate the problem has now been discovered.

15 In a method of curtain coating a plurality of coating liquids on to a travelling web using a curtain coating apparatus of the slide hopper type and wherein a plurality of laminae of coating liquids flows down the  
20 central region of the inclined slide plane of the hopper and wherein in the free-falling curtain at least one of the two edge regions, of width, at least 5 mm, of the curtain comprises liquid which is supplied by a feed  
25 system separate from the system which supplies the coating liquids to the central region of the curtain between the two edge regions, the liquid supplied to the edge region or regions is the same liquid as the  
30 lowest lamina of coating liquid which flows down the inclined slide. Thus there can be no difference in the interfacial tensions of the liquids in contact with the slide no matter what adjustments of concentrations  
35 of surface active agents are made to meet surface tension requirements in the falling curtain.

The method of the present invention finds greatest use when either the lowest  
40 layer of coating liquid as coated on the travelling web or the uppermost layer of coating liquid as coated on the travelling web is a cheap expendable liquid.

45 This can be illustrated by reference to the coating of multi-layer photographic material. In multilayer photographic material sometimes the layer next to the base is a gelatin underlayer. This layer  
50 usually does not contain expensive additives and is sometimes coated as an aqueous gelatin solution containing only surface active agents. Thus it is a relatively cheap expendable solution. Also in most multi-layer photographic materials there is  
55 present as the topmost layer a gelatin supercoat or protective layer. Often this layer contains no additives other than surface active agents and is coated as a relatively cheap aqueous gelatin solution. Therefore, as long as the underlayer gelatin  
60 solution or the supercoat gelatin solution contains only such inexpensive additives but no expensive dye material or photosensitive material it is possible to use such  
65 liquid in the edge regions. Further such

liquid can be collected and reused as described in No. 1,429,260.

The invention will now be described with reference to the drawings which accom-  
70 pany the Provisional Specification in which:—

Figure 1 is a cross-section side elevation of a three layer slide hopper curtain coater of the type shown in Figure 5 of Patent No. 1,429,260 showing the coating of three-layer  
75 photographic material on a web.

Figure 2 is a diagrammatic sectional view of the liquid layer disposition on the inclined slide hopper corresponding to  
80 Figure 1.

Figure 3 is a cross-sectional side elevation of a three layer hopper curtain coater showing the coating of three-layer photo-  
85 graphic material on a web, where the order of layer assembly on the slide is inverted with respect to the order of layer assembly on the coated web.

Figure 4 is a diagrammatic sectional view of the liquid layer disposition on the inclined slide hopper corresponding to  
90 Figure 3.

Figure 5 is a diagrammatic plan view of a three layer slide hopper.

In Figure 1 a travelling web of material 1 is being coated with three layers of coating  
95 liquid. Liquid 2 is a gelatin solution containing surface active agents which when coated on the web 1 and dried constitutes a gelatin underlayer. Liquid 3 is a gelatino silver halide emulsion containing fine grain silver halide crystals and  
100 liquid 4 is a gelatino silver halide emulsion containing coarse grain silver halide crystals. The arrow beneath the web 1 indicates the direction in which the web is travelling. The slide hopper block 5 contains three distribution chambers for the  
105 liquids 2, 3 and 4 and these liquids as in all multi-layer slide hopper coating methods flow down the inclined slide 6 to form before they fall off the end of the hopper a three-layer flow of coating liquid. The coating liquid 2 is the bottom-most liquid on the inclined slide 6. On either side of this  
110 three-layer flow of coating liquid is a single-layer flow of coating liquid 2. This is shown in Figure 2 which shows in front elevation the liquid disposition on the inclined slide 6 just before the liquid falls off the end of the hopper 5. This figure shows that the liquid  
115 in the edge regions is liquid 2 which is the same liquid as the bottom liquid of the liquid layers on the inclined plane 6. The edge guides 7 maintain the width of the liquid on the inclined plane 6.  
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In Figure 3 an alternative arrangement is shown. In this case the coating hopper 10 has been turned through 180° with respect to the travelling web 11 which is travelling  
125 in the direction indicated. The coating

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hopper 10 contains three distribution chambers one for each of the liquids 12, 13 and 14.

5 In this case also photographic material is being coated and the web 11 is a photographic film base on which a gelatin underlayer is not required or has been coated already. Thus the first layer to be coated thereon is coating liquid 12 which is 10 a fine-grain gelatino silver halide emulsion. Next to this is coated liquid 13 which is a coarse-grain gelatino silver halide emulsion. On this is coated supercoat liquid 14 which consists essentially of an aqueous gelatin 15 solution containing surface active agents.

As is shown more clearly in Figure 4 coating liquid 14 is the lowest liquid in the multi-layer liquid assembly which flows down the inclined slide 15 of the hopper 10. 20 Figure 4 shows the disposition of the liquids in the multi-layer liquid assembly towards the end of the slide 15 just before the liquids fall off the end of the slide 15 as a free-falling curtain. This figure also shows that the liquid at each edge region is also liquid 25 14. The edge guides 16 are shown in this Figure.

Preferably there is present on the inclined face 15 of the slide hopper separators which 30 keep separate the liquids 12 and 13 from the edge liquid 14 until central liquid 14 has issued from the central distribution slot and the three layer assembly is established on the slide. The said separators are thin 35 vertical walls preferably made of plastics or metal in contact with the slide and extending parallel to the direction of liquid flow and of height equal to or greater than the depth of liquid flowing down the slide. 40 This is shown in Figure 5 which is a diagrammatic plan view of Figure 3 showing the layout of the slots and guides but not showing liquid.

In this figure the inclined slide 15 is 45 shown. Across the face of this slide there are three central slots, slot 20 from which liquid 12 issues, slot 21 from which liquid 13 issues and slot 22 from which liquid 14 issues. There are two edge slots 23 and 24 50 from which liquid 14 also issues. The liquid edge guides 16 are also shown. Two liquid separators 26 and 27 are present on the inclined slide 15. These separators separate the edge liquid 14 from the liquids 12 and 13 55 until liquid 14 issues from the slot 22.

Thus in the method of the present invention the liquid which is lowest on the face of the slide hopper as the multi-layer liquid assembly approaches the end of the 60 slide face and falls as a free-falling curtain is the same as and contains the same additives as the liquid at each edge region. This eliminates any difference in interfacial or surface tension between these two liquids

and thus prevents the width of the liquid in the edge region on the slide or in the curtain becoming either too narrow or too wide. 65

If the central region of the curtain has been adjusted in width to be slightly smaller than the web being coated then if the width 70 of the edge regions containing cheap coating liquid becomes too wide then too much of this liquid would be coated onto the web and the amount of coated web to be slit away would be greater than is desirable. If on the other hand the width of 75 the edge regions becomes too narrow then the width of the central region could be greater than the width of the web and thus some of the expensive coating liquid would fall over the edge of the web and be lost. Further, if the width of the edge region becomes either too narrow or too wide, the associated change in width 80 of the central flow produces local changes in the thickness of the coated layers near the edges. This impairment of the uniformity may be unacceptable.

The method of the present invention helps to prevent either of these two 90 occurrences, which can be caused by differences in interfacial tension on the slide hopper of the bottom layer of liquid and the liquid in the edge regions, by ensuring that these two liquids are the same. 95

#### WHAT WE CLAIM IS:—

1. In a method of curtain coating a plurality of coating liquids on to a travelling web using a curtain coating apparatus of the slide hopper type and wherein a plurality of laminae of coating liquids flows down the central region of the inclined slide plane of the hopper and wherein in the free-falling curtain at least one of the two edge regions, of width, at least 5 mm, of the curtain 100 comprises liquid which is supplied by a feed system separate from the system which supplies the coating liquids to the central region of the curtain between the two edge regions, the liquid supplied to the edge region or regions is the same liquid as the lowest lamina of coating liquid which flows down the inclined slide. 105

2. A method according to claim 1 wherein the travelling web is photographic base and the coating liquids are photographic coating liquids. 110

3. A method according to claim 2 wherein the liquid of the lowest lamina of coating liquid which flows down the inclined slide is an aqueous gelatin solution which contains substantially no additives other than wetting agents. 120

4. A method of curtain coating a plurality of coating liquids on to a travelling web according to claim 1 substantially as hereinbefore described. 125

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